

UNIVERSITY OF CALIFORNIA.

AGRICULTURAL EXPERIMENT STATION.

BULLETIN NO. 54.

Condensed Grape Must and Its Uses.

The evaporation of must for the purpose of rendering it cheaply transportable and capable of almost indefinite conservation, is an industry of quite recent origin. Cider boiled down to the consistency of jelly has been in the Eastern markets for some time, has found considerable acceptance for table use, and has formed a means of utilizing fruit which, from various causes, could not find its way to a profitable market. The evaporation of grape must for similar uses was begun by the late Mr. J. C. Weinberger, of St. Helena, at the time when it seemed necessary to find other outlets than wine-making for the grape product of California. Samples of the syrup then made are preserved at the University, and the results of its examination were given in the report of the agricultural department of the University for 1877. Mr. Weinberger had, it seems, clarified the grape juice just as is done in the case of cane juice, with lime; thus throwing down all the tartaric acid in the insoluble form, together with other non saccharine ingredients. The must thus treated formed, after boiling down, at first a dark, molasses-like syrup, which soon became so much filled with granulated grape sugar as to render it wholly or partially solid. In that form it was unacceptable to the trade, though very pleasant to the taste. From that cause, as well as from the revival of the wine interest that soon followed, the manufacture was abandoned.

Within the last few years the evaporation of must has been prominently broached in Europe as a means of supplying to distant wine-making districts the ingredients needed to make up the deficiencies in the quality or quantity of their wines, from regions where wine-making could not be as advantageously carried on. It was at once understood that in order to maintain in the evaporated must the conditions for a healthy fermentation, it is necessary to conduct the condensing process at the lowest temperature possible; and the vacuum pans employed in sugar refining were naturally resorted to for the purpose. Excellent results were reported from the use of must so condensed, in the "correction" of more or less faulty musts or wines. It thus becomes possible to apply the principles of the "gallizing" and "petiotizing" processes, without the use of any ingredients foreign to the grape.

In the use of the ordinary vacuum pan, however, the process is of necessity interrupted from time to time, for the discharge of the condensed product. It is evidently very desirable, for this as well as for many other purposes, to make the evaporating process a continuous one, as is done in the distillation of wines etc., by the use of the Desorme or Egrot apparatus. This object has been very fully and conveniently attained by the "Yaryan" evaporator, in which the must to be condensed flows through a system of pipes that is surrounded, throughout its length, by similar but wider pipe, forming a steam jacket by which the interior pipe is uniformly heated throughout its length. By connecting the latter with an air exhaust, as in the common vacuum pan, the boiling and consequent evaporation of the must (or other liquid) takes place at so low a temperature that its nature is changed but very little. It does not acquire a "cooked" taste, but simply loses its water; and when the latter is afterwards again added to the proper extent, a must is produced which few persons would distinguish from the freshly pressed product. Those desiring to see grape juice supersede fermented wine in daily use could hardly find or desire a more complete solution of the problem of its preservation for use throughout the year.

The evaporated must issues from the apparatus in the form of a brownish syrup; but on cooling, it after some time congeals into a thick granular paste, possessing, in the case of the Muscat, Catawba and similarly scented varieties, the distinct flavor of the grape. The sweet, acidulous paste is quite tempting for table use in place of other sweets; but it must not be forgotten that it contains enough of cream of tartar to form quite a purgative dose if indulged in too freely.

During the past vintage season a "Yaryan" evaporator was operated for some time at the Bugby vineyard near Folsom, by Mr. T. D. Cone, the agent in charge of its introduction in California. The must from about 60 tons of grapes of various kinds was evaporated and shipped East to the "Lenk Wine Company" of Toledo, Ohio, who fermented it in various ways, partly by itself, partly with other grapes of Eastern growth, in order to test its behavior in wine-making. Two series of similar tests were made in California, one by the Viticultural Commission and one at the University laboratory. In the latter only white wines were made, and from Zinfandel must, no other being available at the time in sufficient quantity. The composition of the condensed musts used in the latter experiments was as follows:

	Solid Contents	Acid as Tartaric	Ash
Zinfandel, 1st crop.....	74.80	1.511	.967
Zinfandel, 2d crop.....	68.00	1.639	.634

No analyses of the original grapes had been made; but it is evident from the figures of the table that in the first-crop must, the condensation had been to the extent of about 3 to 1, which agrees with Mr. Cone's estimate: while in the second-crop must the evaporation had stopped short of that proportion, and the mass was noticeably more liquid. The characteristics of the second-crop are apparent in the high acid and low ash, as compared with the same data in the first crop.

Under the microscope, both alike appear as a mass of minute glucose crystals, mingled with those of cream of tartar, and numerous fruit cells, partly whole, partly ruptured; showing that the must had not been filtered before evaporation.

On October 27th, 1885, a quantity of the first-crop condensed must was diluted with water so as to reduce the solid contents to 24.13 per cent, making up five gallons of must, and was placed in the fermenting room at 70 degrees, without the addition of anything to start fermentation. Frothing and fermentation commenced within 24 hours, and on Oct. 29th, reached the maximum temperature of 83 degrees. The temperature then fell slowly until on Nov. 10th, it reached the cellar temperature of 70 degrees, two weeks from the beginning. The wine was racked from the lees on Nov. 24th, fairly clear.

A precisely similar experiment was started on November 6th, with must of the second crop, diluted to practically the same sugar contents. Here also, the fermentation started spontaneously within 18 hours of the setting. It seemed rather more vigorous than in the first-crop must; reached the same maximum temperature of 83 degrees on November 9th, but had already fallen to the cellar temperature of 69 degrees on November 12th, thus completing its active fermentation much more quickly than the first-crop must. It was racked at the same time as the latter—on November 24th—quite clear.

A third fermentation experiment was made with the must of the second crop, diluted, as before, but filtered before setting for fermentation on November 21st. The starting of the fermentation seemed in this case to be as prompt as before, but it progressed very slowly. The keg was therefore transferred to a warm chamber and there completed the fermentation, under an external temperature of 80 degrees, by December 14th, when the wine was racked from the lees. It showed a faint milky turbidity, which it has ever since maintained.

Two blends were also made—one with 50 per cent of Burger, from D. C. Feely, Patchen; another, with two and one-half per cent of

Verdal, purchased in the market, and which was first allowed to start into active fermentation before blending. In both cases the course of the fermentation was very nearly the same as in the unblended must of the same (first) crop.

It appears from the above experiments that the condensed must starts its fermentation as readily as the fresh, but that for this purpose it should remain unfiltered, retaining the mechanically floating matter that runs with it from the press. The second-crop must, with high acid, completed its fermentation quite as rapidly as any fresh must; but in the first-crop product the course of the fermentation seemed to lag somewhat.

In taste the white Zinfandel wines thus made are remarkably neutral. The character of the grape, such as is perceived in white wines made from fresh must, is nearly or quite unrecognized. Such neutral wine would, of course, find its good use in blending; but samples of Chasselas, Muscat and Catawba wines made by the Lenk Company, at Toledo, do not exhibit this neutrality, but possess, in a marked degree, the peculiar aromas of the respective grapes. It will therefore be necessary to determine for each grape variety the effect produced upon the wine by the previous condensation of the must, and govern its proper blends accordingly.

The tendency to a lagging of the fermentation in the case of a first-crop must, alluded to above, with a certain lack of character observable in the young wines, alone points to the propriety of using the condensed must and wines mainly in blends; preferably of course in "grape blends," made before fermentation with the grape that is intended to give the prominent character to the wine.

There is another point which thus far is merely a probable presumption from the short experience had, viz., that when fermented *by themselves*, the condensed musts have a tendency to go into "milk-sourness," which is slightly perceptible in several of the samples, both in those fermented here and in those brought from the East. The second-crop-must fermented at the University is, however, perfectly sound in every respect; and it can scarcely be doubted that a little study of the matter will teach how to counteract this tendency and thus obviate the possible danger to the soundness of wines.

Taking this for granted it is not easy to over-estimate the possible importance of the condensed must industry to the grape-grower. It enables the producer to transform his crop into a compact, merchantable product even more quickly than is done in raisin-making, and to preserve it indefinitely for a variety of purposes, some of which may yet be developed. The invalid desiring to use the "grape cure" can have it where and whenever he wants it; and grape must can be dispensed at all seasons, from the torrid zone to the Arctic, at a cost originally much less than lime juice, and at

one-third the cost of transportation and packages. Winemaking can be transferred from unfavorable localities and seasons to favorable ones; and a supply of condensed must, made up early in the season or kept over from the previous year, could be used to correct defects of fermentation such as occurred during the past vintage, to overcome the "arrest of fermentation" so much complained of, and which has given rise to so much unsound wine. Experience will soon show what kinds of must it would be especially desirable to devote to such purposes, and it is extremely probable that some grape varieties now little valued, but very productive, would be habitually utilized in this way, whether at home or after exportation.

It still, of course, remains to be seen how far such advantages as these can be realized on the large scale, taking into consideration the cost and producing capacity of the apparatus. From the fact that it is now extensively employed in the utilization of such a low-value by-product as slaughter-house tankage, it would seem probable that it would not fail of satisfactory performance in the case of grape juice. It is to be hoped that a more extended experience during the coming vintage, both as regards the performance of the apparatus and the utilization of the product, will set at rest all the more important questions connected with the subject.

The table below shows the composition of some of the wines made from condensed musts.

Analyses of Wines from Condensed Must, Vintage of 1885.

WINES MADE AT UNIVERSITY LABORATORY.

WINES.		Solid Contents by Spindle.	Acid	Ash	Sugar	ALCOHOL.	
						Weight.	Volume.
No. 31.—1st Crop {	Musl	24.13	.48	.312	24.13		
Zinfandel.....	Win	2.30	.481	.244	trace	11.23	13.73
No. 40.—2d Crop {	Musl	24.02	.579	.274	24.02		
Zinfandel.....	Win	2.15	.525	.140	none	10.54	13.00
No. 41.—2d Crop {	Musl	as me as No. 40	24.02				
Zinfandel, filtered	Win	2.60	.576	.187	none	10.54	13.00
WINES MADE BY LENK WINE CO., TOLEDO.							
Chasselas.....	Wine	2.58	.496	.500	some	10.81	13.27
Mission.....	Wine	2.58	.435	.300	some	9.92	12.86
Muscat.....	Wine	4.20	.750	.290	mu'h	8.84	11.00
Catawba.....	Wine	2.00	.696	.250	none	10.26	12.73

It will be seen that in their composition these wines do not differ from those that might be looked for from fresh juice of the same grape varieties, save that the last two show an abnormally high acid. In the case of the Muscat sample this is accompanied by very distinct "milk-sourness," which is also perceptible in the Catawba, and very lightly in the University sample No. 31. That this fault is doubtless avoidable has been stated above.

E. W. HILGARD.

Berkeley, April 23, 1886.